

ADVANCED ANALYSIS AND DESIGN OF POLYMER SHEET EXTRUSION

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ABSTRACT

A manufacturing process design methodology is presented which can be used to improve the production of polymer components manufactured via the extrusion. The design methodology employs polymer process modeling, design sensitivity analysis, and numerical optimization. Specifically, this research investigates the optimization-based design methodology of polymer extrusion including the analysis of Generalized Newtonian Fluid (GNF) models, the adjustable features of die designs under multiple operating conditions, fluid-structure interaction, and non-isothermal analysis for fully-coupled nonlinear steady-state temperature and pressure systems. The main objective of this research is to develop the design methodologies of polymer extrusion and their applicability in efficiently modeling and simulating polymer processing and industrial die designs.

An example of industrial extrusion die and various polymers (LDPE, PP, LLDPE) are provided to exemplify the polymer processing design methodology. From the result of this research, it is shown that the proposed methodologies can be effectively used to design polymer extrusion dies in which the die cavity geometry is computed to minimize the pressure drop while delivering a uniform exit velocity and a uniform temperature.